Chapter 17A

Structural Tests and Inspections

Comparison Summary

The structural tests and Inspection chapters, Chapter 17 in the *IBC* and Chapter 40 of *NFPA 5000*, provide the regulations needed to assure that projects are properly constructed. The tests and inspection chapter plays a key role in the effort to achieve structural safety. These chapters set forth the nature and frequency of tests and inspections made during construction. The format and presentation of the structural tests and Inspection chapters in the two model codes vary significantly.

IBC 2003

Chapter 17 of the *IBC* is 15 pages long, and is divided into 15 sections. The chapter has been organized differently compared to the *CBC*, and includes extensive tables for each structural material that list the type and frequency of required tests, inspections, and special inspections. An excellent feature of these tables is the inclusion of specific citations to the appropriate code sections and referenced standard sections. This greatly simplifies the task of locating the appropriate information on the required test or inspection. Some tests and inspections are triggered by Seismic Design Category, a change from current OSHPD practice that applies uniform requirements state wide. The *IBC* contains specific observations that must be performed for wind design concerns, something not found in the *CBC*. *IBC* Chapter 17 contains a specific section on Material and Test Standards, a new feature to the model code that is currently covered through ICBO acceptance criteria.

In general, *IBC* Chapter 17 is an improvement over *CBC* Chapter 17, providing greater coverage of the subject in a much-improved format.

NFPA 5000

In *NFPA 5000*, structural tests and Inspection is covered in the 8 pages of Chapter 40. The overall philosophy and approach in *NFPA 5000* is significantly different from that found in either the *CBC* or the *IBC*. The Registered Design Professional (RDP) is given extensive authority over the Quality Assurance Program, establishing both the extent and frequency of tests and inspections. Minimum standards for frequency and extent of tests and inspections would have to be established by amendment, and coordinated with OSHPD's Part 1, Title 24 and other Part 2 provisions. While Chapter 40 provisions and *NFPA 5000* Section 1.7.6.6.3.4 (N) prescribe required special inspections; we could not locate qualification criteria or approval requirements for special inspectors (referred to as "Agent", per *NFPA 5000* Section 40.2.1) or material test laboratories.

NFPA 5000 Section 40.1.5 requires that the Owner directly or indirectly retain RDPs to prepare and administer quality assurance program. RDPs recommend inspectors (Agents) to the authority having jurisdiction. It is unclear who actually hires the

inspectors. The various tables in Chapter 40 provide only the “Item” and “Scope” of the object to be tested or inspected. There are no references to specific code sections or referenced publication sections.

Summary

IBC Chapter 17 covers structural tests and inspections in a more user-friendly manner, by providing direct references to test and inspection provisions. The lack of definition of a minimum scope and frequency of tests and inspections in *NFPA 5000* is a great concern. *NFPA 5000* Chapter 40 will require a significantly greater number of amendments to reach a level of performance comparable to that found in the *CBC* or *IBC* Chapter 17.

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2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
-	**1701 – GENERAL** 1.1 Scope – Covers quality, material and requirements for material.	Minimal effect
-	1.2 New materials 1.3 Used materials	IBC Sec. 1701.3 permits use of used materials, provided they meet code requirements for new materials No requirements for use of reclaimed materials are found in Chapter 17A of CBC. Requirements for use of reclaimed masonry are in Chapter 21A.
-	**1702 – DEFINITIONS**	Some definitions in IBC may need clarification. Approved Agency is defined as an established and recognized agency engaged in conducting tests and doing inspections
-	**1703 – APPROVALS** 1. Approved agency 1.1 Independent 1.2 Equipment 1.3 Personnel 3.2 Written approval 3.3 Approved record Building dept. to keep approvals on file and open to public inspect. 3.4 Performance 3.4.1 Research and investigation 3.4.2 Research reports	No effect to OSHPD program since Title 24 Part 1 provisions prescribe similar requirements.
1701A – SPECIAL INSPECTIONS A.1 General *A.1.2 Owner to employ special inspectors and project inspector*. *A.2.2. Qualification and approval of project and special inspectors*	**1704 – SPECIAL INSPECTIONS** 4.1 General.	IBC contains substantially more clarification of requirements for special inspections, no effect to OSHPD program due to provisions contained in Part 1, Title 24.
-	4.1.1 Building permit requirements	No effect to OSHPD program
A.3 Duties and Responsibilities of the *Project and* Special Inspectors *A.3.2 Inspector to observe work and submit verified reports*	4.1.2 Inspection report requirements	No effect to OSHPD program

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2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
A.4 Standards of Quality Concrete – ASTM C94 Connections - ASTM A325 or A490 Spray-applied Fire-resistive Materials – UBC Standard 7-6	See 1704 provisions and tables for material types	Similar
A.5 Types of Work Requiring Constant Presence of the Project or Special inspector Item 1. Concrete Item 2. Bolts installed in concrete	4.4 Concrete construction. Special inspection Except for: Pad footings for buildings 3 Stories Continuous wall footings for buildings 3 Stories Concrete or Masonry foundation walls constructed per 36.6.2 4.4.1 Materials test in absence of sufficient documentation of conformance with ACI 318-Chapter 3	Similar
Item 3. Special moment-resisting concrete frame	TABLE 1704.4 - REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION	Continuous inspection in both IBC and CBC. No effect.
Item 4. Reinforcing steel and prestressing steel tendons	TABLE 1704.4	No specific requirements in IBC.
Welding Reinforcing steel	1704.4 Concrete Construction Item 2 of TABLE 1704.4	Periodic placement of reinforcement steel including prestressing tendons required by IBC, continuous by CBC.
Item 5. Structural welding. General. Special moment-resisting steel frames.	1704.3 Steel construction 4.3.1 Welding 4.3.2 Details 4.3.3.1 General 4.3.3.2 Periodic monitoring 4.3.3.3 Cont. monitoring TABLE 1704.3 - REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION	Similar; IBC provides more clarity of required tests & inspections
6. High-strength bolting	4.3.3 High-strength bolts TABLE 1704.4 and 1704.3	Similar
7. Structural masonry & 2105A Quality Assurance	4.5 Masonry construction. 4.5.1 Empirically designed masonry, glass unit masonry and masonry veneer in essential facilities. 4.5.2 Engineered masonry in nonessential facilities	Continuous inspection for welds except single pass welds and metal decking. Continuous or periodic inspection for slip critical bolts depending on method of tightening.

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2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	4.5.3 Engineered masonry in essential facilities	
8. Reinforced gypsum concrete	TABLE 1704.5.1 - LEVEL 1 SPECIAL INSPECTION TABLE 1704.5.3 - LEVEL 2 SPECIAL INSPECTION	Scope of test and inspection in IBC is greater than CBC.
9. Insulating concrete fill.	-	No provisions found in IBC
10. Spray-applied fire-resistive materials	4.11 Sprayed fire-resistant materials 4.11.1 Structural member surface conditions 4.11.2 Application. 4.11.3 Thickness 4.11.4 Density. 4.11.5 Bond strength	Similar – IBC provides more clarity of required tests/inspections
11. Piling, drilled piers and caissons	4.8 Pile foundations 4.9 Pier foundations	Similar
12. Shotcrete	1704.4 Concrete Construction Item 6 – Table 1704.4	Similar
13. Special grading, excavation and filling	1704.7 Soils. EXCEPT placement of fill less than 12 inches deep. 4.7.1 Site preparation 4.7.2 During fill placement 4.7.3 Evaluation of in-place density	Similar
14. Smoke-control system	1704.14 Special inspection for smoke control. 4.14.1 Testing scope 1. leakage testing prior to concealment 2. Prior to occupancy 4.14.2 Qualifications	Similar
15. Special cases	4.13 Special cases. Special inspections for work in the opinion of the building official is unusual in nature	Similar
16. Manufactured trusses OSHPD amendment provision		Continue OSHPD amendment
17. Glued-laminated Timber OSHPD amendment provision	-	Continue OSHPD amendment
18. Post Installed Anchors. OSHPD amendment provision	-	Continue OSHPD amendment
-	4.6 Wood construction. 4.6.1 Fabrication of High-Load	No effect to OSHPD program

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2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	Diaphragms	
	4.10 Wall panels and veneers 4.12 Exterior insulation and finish systems (EIFS)	No effect to OSHPD program
SECTION 1702A . OBSERVATION OF THECONSTRUCTION -		Continue OSHPD amendment
SECTION 1703A . NONDESTRUCTIVE TESTING	-	Continue OSHPD amendment
1704A – PREFABRICATED CONSTRUCTION	1704.2 Inspection of Fabricators	Similar
-	3.5 Labeling 3.5.1 Testing 3.5.2 Inspection and Identification 3.5.3 Label information.	No specific requirements for labeling in CBC chapter 17A. There are some requirements in the product sections of the CBC. (e.g. Glued-Laminated Timbers – Section 2337A.1)
A.1 General A.1.1 Purpose A.1.2 Scope – all prefabricated construction A.1.3 Definition of prefabricated assembly A.2 Tests of Materials A.3 Tests of Assemblies A.4 Connections A.5 Pipes and Conduits A.6 Certificate and Inspection A.6.1 Materials A.6.2 Certificate A.6.3 Certifying agency A.6.4 Field erection A.6.5 *Constant* inspection	3.6 Heretofore approved materials 3.7 Evaluation and follow-up inspection services. 3.7.1 Follow-up inspection. 3.7.2 Test and inspection records 4.2 Inspection of fabricators. 4.2.1 Fabrication and implementation procedures 4.2.2 Fabricator approval.	No effect to OSHPD program; Title 24 Part 1 provisions similar.
-	**1705 – QUALITY ASSURANCE FOR SEISMIC RESISTANCE** 5.1 Scope 5.2 Quality assurance plan preparation. each designated seismic system shall include a quality assurance plan prepared by a registered design professional	No provisions in CBC specific to a particular seismic zone. Minimal impact to OSHPD program.

2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	5.3 Contractor responsibility. submit a written contractor's statement of responsibility to the building official and to the owner	
-	**1706 – QUALITY ASSURANCE FOR WIND REQUIREMENTS** 6.1 Scope quality assurance plan 6.1.1 When required 1. Wind exposure categories A and B, 3-second-gust wind speed is 120 mph or greater. 2. Wind exposure categories C and D, 3-second-gust wind speed is 110 mph or greater. 6.1.2 Detailed requirements. 6.2 Quality assurance plan preparation. each main wind-force-resisting system and component shall include a quality assurance plan 6.3 Contractor responsibility. shall submit a written contractor's statement of responsibility to the building official and owner	No provisions in CBC specific to a particular wind zone. Minimal impact to OSHPD program.
-	**1707 – SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE** 7.1 Special inspections for seismic resistance. 7.2 Structural steel 7.3 Structural wood 7.4 Cold-formed steel framing 7.5 Storage racks and access floors 7.6 Architectural components 7.7 Mechanical and electrical 7.7.1 Component inspection. 7.7.2 Component and attachment testing. 7.7.3 Component manufacturer certification.	No provisions in CBC specific to a particular seismic zone. Some systems are regulated under the IBC and not regulated under the CBC. Minimal impact to OSHPD program.

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2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	7.8 Seismic isolation system.	
1703A – NONDESTRUCTIVE TESTING *A.1* Welded, fully restrained connections …ordinary moment frames and special moment-resisting frames	**1708 – STRUCTURAL TESTING FOR SEISMIC RESISTANCE** 1708.1 Masonry 1708.1.1 Empirically designed masonry and glass unit masonry in nonessential facilities 1708.1.2 Empirically designed masonry and glass unit masonry in essential facilities 1708.1.3 Engineered masonry in nonessential facilities 1708.1.4 Engineered masonry in essential facilities. 1708.2 Testing for seismic resistance 1708.3 Reinforcing and prestressing steel. TABLE 1708.1.2 - LEVEL 1 QUALITY ASSURANCE TABLE 1708.1.4 - LEVEL 2 QUALITY ASSURANCE 1708.4 Structural steel 1708.5 Mechanical and electrical equipment 1708.6 Seismically isolated structures. For required system tests, see 9.13.9 of ASCE 7.	Provisions in CBC are not triggered by seismicity. Scope of test and inspection in IBC is greater than CBC, but not greater than OSHPD-amended code provisions. No effect to OSHPD program.
1702A – OBSERVATION OF THE CONSTRUCTION A.1 (OSHPD) references Title 24, Part 1 Sec. 4-333 and 4-341	**1709 – STRUCTURAL OBSERVATIONS** 1709.1 Structural observations. Structural observations shall be provided for those structures included in Seismic Design Category D, E or F. Structural observations shall also be provided for those structures sited where the basic wind speed exceeds 110 miles per …	There are no specific requirements in the CBC for structural observation in areas of high seismicity and wind. It appears structural observation is only required by the IBC under this section. Minimal impact to OSHPD program.
-	**1710 - DESIGN STRENGTHS**	CBC provisions contained in material

2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	OF MATERIALS 10.1 Conformance to standards 10.2 New materials	chapters, no significant effect to OSHPD program.
-	**1711 – ALTERNATIVE TEST PROCEDURE** 11.1 General. In the absence of approved rules or other approved standards	No requirements in CBC, but minimal impact to OSHPD program.
-	**1712 – TEST SAFE LOAD** 12.1 Where required. Where proposed construction is not capable of being designed by approved engineering analysis…	No requirements in CBC, minimal impact to OSHPD program.
-	**1713 – IN-SITU LOAD TESTS** 13.1 General. 13.2 Test standards-standards listed in Chapter 35 13.3 In-situ load tests 13.3.1 Load test procedure specified-standards listed in Chapter 35. 13.3.2 Load test procedure not specified procedure developed by a registered design professional that simulates applicable loading and deformation conditions	No requirements in CBC, minimal impact to OSHPD program.
-	**1714 – PRECONSTRUCTION LOAD TESTS** 14.1 General. 14.2 Load test procedures specified design standards listed in Chapter 35 14.3 Load test procedures not specified. simulate loading conditions specified in Chapter 16. 14.3.1 Test procedure. 1. The load at the deflection limitation given in 1714.3.2. 2. The failure load divided by 2.5. 3. The maximum load applied	No requirements in CBC, minimal impact to OSHPD program.

2001 CBC – Chapter 17A	IBC – Chapter 17	Comments
	divided by 2.5. 14.3.2 Deflection. limitations in 1604.3. 14.4 Wall and partition assemblies. Testing 14.5 Exterior window and door assemblies. design pressure rating determined 14.5.1 Aluminum, vinyl and wood exterior windows and glass doors. labeled 14.5.2 Exterior windows and door assemblies not provided for in 14.5.1 shall be tested 14.6 Test specimens	
-	**1715 – MATERIAL AND TEST STANDARDS** 15.1 Test standards for joist hangers and connectors. 15.1.1 Test standards for joist hangers 15.1.2 Vertical load capacity for joist hangers 15.1.3 Torsional moment capacity for joist hangers 15.1.4 Design value modifications for joist hangers 15.2 Concrete and clay roof tiles. 15.2.1 Overturning resistance 15.2.2 Wind tunnel testing	New to code, but currently addressed through acceptance criteria for structural hardware (ICBO AC), UBC Std. 15-5, etc., no significant differences from current requirements.

Chapter 17A - Structural Tests and Inspections

2001 CBC – Chapter 17A	NFPA 5000 – Chapter 40	Comments
-	**40.1 General** 40.1.1 Scope 40.1.2 Purpose	Chapter 40 prescribes requirements for quality assurance, defined per Sec. 40.2.4 to include tests, inspections, and observations. This scope is similar to CBC Ch. 17A scope. Amend Chapter 40 to remove conflicts with Title 24 Part 1 provisions applicable to OSHPD's program. Part 1 provisions are not specific as to required special inspections/tests, this is currently addressed in Chapter 17A, Part 2. Chapter 40 provisions and Section 1.7.6.6.3.4 (N) prescribe required special inspections; could not locate qualification criteria or approval requirements for special inspectors (agent, per 40.2.1) or material test laboratories. OSHPD will amend to continue current requirements for OSHPD program.
-	40.1.3 Extent of Quality Assurance 40.1.3.2 Registered Design Professional (RDP) shall determine the frequency and extent of the applicable tests, inspections, and observations required …	Minimum standards for frequency and extent must be established by amendment, coordinate with OSHPD's Part 1, Title 24 and other Part 2 provisions (e.g. materials chapters).
-	40.1.4 Structures Requiring Quality Assurance 40.1.4.1 Quality Assurance Programs in Seismic Design Categories C, D, E, and F. 40.1.4.2 Quality Assurance Programs in High Wind Zones.	No impact to OSHPD program, due to Part 1, Title 24 provisions, but amend to clarify.
-	40.1.4.3 Structures, Components, Assemblies, and Systems not Requiring a Quality Assurance Program. 1) Pad footings for buildings > 3 Stories 2) Continuous wall footings for buildings > 3 Stories … 3) Concrete or Masonry foundation walls constructed per 36.6.2	Repeal provision to remove conflict with OSHPD requirements contained in Title 24, Part 1.
1701A – SPECIAL INSPECTIONS A.1 General	40.1.5 Involvement of the Owner and Registered Design Professional	Owner to directly or indirectly (repeal "indirectly") retain registered Design Professionals (RDP) to prepare and administer quality assurance program.

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2001 CBC – Chapter 17A	NFPA 5000 – Chapter 40	Comments
A.1.2 Special Inspectors in addition to project inspector. A.2 *Project and* Special Inspector *A.2.2 Inspector Qualifications*		RDP(s) recommend inspectors (Agents) to the authority having jurisdiction. It is unclear who actually hires the inspectors.
-	40.1.6 Responsibility of the Contractor 40.1.7 Building Permit	No provisions in current CBC Vol. 2. Enforcement role with QC plan new to code. Evaluate and determine whether or not to amend to clarify.
A.3 Duties and Responsibilities of the *Project and* Special Inspectors *A.3.2 Inspector to observe work and submit verified reports*	40.1.8 Reports 40.1.9 Remedial Action 40.1.10 Final Report	Registered design professional (RDP) provides final report. Amend 40.1.8 to require all test/inspection reports to be sent to OSHPD as well as RDP.
-	40.1.11 Performance Specification	Amend to require approval by OSHPD of contractor-designed components, assemblies or systems.
-	**40.2 Special Definitions**	Some definitions in NFPA may need clarification. Agent defined as qualified company or individual assigned to execute a specific test, inspection or observation.
A.4 Standards of Quality Concrete – ASTM C94 Connections - ASTM A325 or A490 Spray-applied Fire-resistive Materials – UBC Standard 7-6	Addressed in material provisions Referenced In ACI 318 - **40.5 Quality Assurance for Sprayed Fire-Resistive Materials**	Similar
1702A – OBSERVATION OF THE *CONSTRUCTION* *A.1- Observation by Architect or Engineer in responsible charge.*	**40.3 Quality Assurance for Structural Components and assemblies** 40.3.1 Scope 40.3.2 Structural Observation 40.3.3 Structural Test and Inspections 40.3.4 Inspection of Fabricators 40.3.4.2 Inspection During Fabrication	Amend to comply with Title 24, Part 1 provisions.
1701A.5 Types of Work *Requiring Constant Presence of the Project or Special inspection*	40.3.7 Cast-in-Place Concrete Construction Table 40.3.7 Cast-in-Place Concrete Construction	Frequency of testing determined by RDP, amend to comply with CBC requirements, which are specific (e.g. concrete sampling, masonry core tests, reinforcement steel

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2001 CBC – Chapter 17A	NFPA 5000 – Chapter 40	Comments
1. Concrete 2. Bolts installed in concrete	Concrete Construction Table 40.3.8 Precast Concrete Construction	tests).
3. Special moment-resisting concrete frame	-	No specific requirements found in NFPA 5000, review ASCE 7-02.
4. Reinforcing steel and prestressing steel tendons Welding Reinforcing steel	Table 40.3.7 Cast-in-Place Concrete Construction	Frequency of testing determined by RDP, amend as noted above.
5. Structural welding. General. Special moment-resisting steel frames. Welding Reinforcing steel (see #4) 6. High-strength bolting	40.3.10 Steel Construction Table 40.3.10(a) Steel Construction	Frequency of testing determined by RDP, amend as noted above.
7. Structural masonry	40.3.9 Masonry Construction	Frequency of testing determined by RDP in NFPA. Amend ACI 530 Sec. 1.14 QA provisions to clarify QA program requirements and qualification criteria for material test laboratories and inspectors.
8. Reinforced gypsum concrete	41.8.3 Testing (Reinforced Gypsum Concrete)	Minimal impact
9. Insulating concrete fill.	-	No provisions found in NFPA
10. Spray-applied fire-resistive materials	**40.5 Quality Assurance for Sprayed Fire-Resistive Materials** Table 40.3.5.1.2 Sprayed Fire-Resistive Materials 40.5.2 Density 40.5.3 Bond Strength	Frequency of testing determined by RDP in NFPA.
11. Piling, drilled piers and caissons	40.3.6 Foundations Table 40.3.6(a) Pile Foundations Table 40.3.6(b) Pier Foundations	Frequency of testing determined by RDP in NFPA.
12. Shotcrete	Table 40.3.7 Cast-in-Place Concrete Construction	Frequency of testing determined by RDP in NFPA.
13. Special grading, excavation and filling	40.3.5 In-situ Soils and Controlled Structural Fill Table 40.3.5.1 In-situ Bearing Strata for Footings	Frequency of testing determined by RDP in NFPA.

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2001 CBC – Chapter 17A	NFPA 5000 – Chapter 40	Comments
	Table 40.3.5.2 Controlled Structural Fill (Prepared Fill)	
14. Smoke-control system	40.6 Quality Assurance for Smoke Control Systems	Quality assurance program prepared by RDP in NFPA.
15. Special cases	40.3.12 Special Cases	
16. Manufactured trusses 17. Glued-laminated Timber	40.3.11 Wood Construction Table 40.3.11 Wood Construction	Frequency of testing determined by RDP in NFPA.
18. Post Installed Anchors.	Table 40.3.10(a) Steel Construction - Item 11.	Frequency of testing determined by RDP in NFPA.
-	Table 40.3.10(b) Light-Framed Cold-formed Steel Construction	Frequency of testing determined by RDP in NFPA.
-	**40.4 Quality Assurance for Wall Finish Systems** 40.4.1 Scope 40.4.2 Exterior Insulation and Finish Systems (EIFS)	No specific requirements in CBC. Within scope of project inspector's work. Minimal impact.
-	**40.7 Quality Assurance for Stairs and Railings**	
-	**40.8 Quality Assurance for Nonstrucutral Componnets and Systems.** ASCE 7, Section A9.3.	
-	**40.9 Quality Assurance for Penetrations and Joints**	
SECTION 1702A . OBSERVATION OF THE CONSTRUCTION		Continue OSHPD amendment
1703A – NONDESTRUCTIVE TESTING *A.1* Welded, fully restrained connections …ordinary moment frames and special moment-resisting frames	-	No specific provisions in NFPA, see Table 40.3.10(a), refers to project specifications (which are not codified).
1704A – PREFABRICATED CONSTRUCTION	40.3.4.1 Prefabricated construction	Evaluate for amendment to clarify that material tests and inspections will be required as for site-constructed materials, and no waiving of requirements will be permitted by the RDP (see 40.3.4.1.1).